Overview of Astrophysics with MINOS FarDet

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Astrophysics w/ MINOS-FD

Fundamentally, we have a B-field, this is a unique feature of our detector, let's use it...

(momentum analysis + charge-sign)

atmospheric ν $\Rightarrow$ $\nu/\bar{\nu}$

+ energy spectrum

Cosmic rays $\Rightarrow$ μ^+/μ^-

@ very high energy

ν/μ astronomy $\Rightarrow$ energy resolution + separation from atm

Sources of extra-terrestrial neutrinos

Gamma ray bursts

Active Galactic Nuclei

Pulsars

(WIMPS)

Strategies

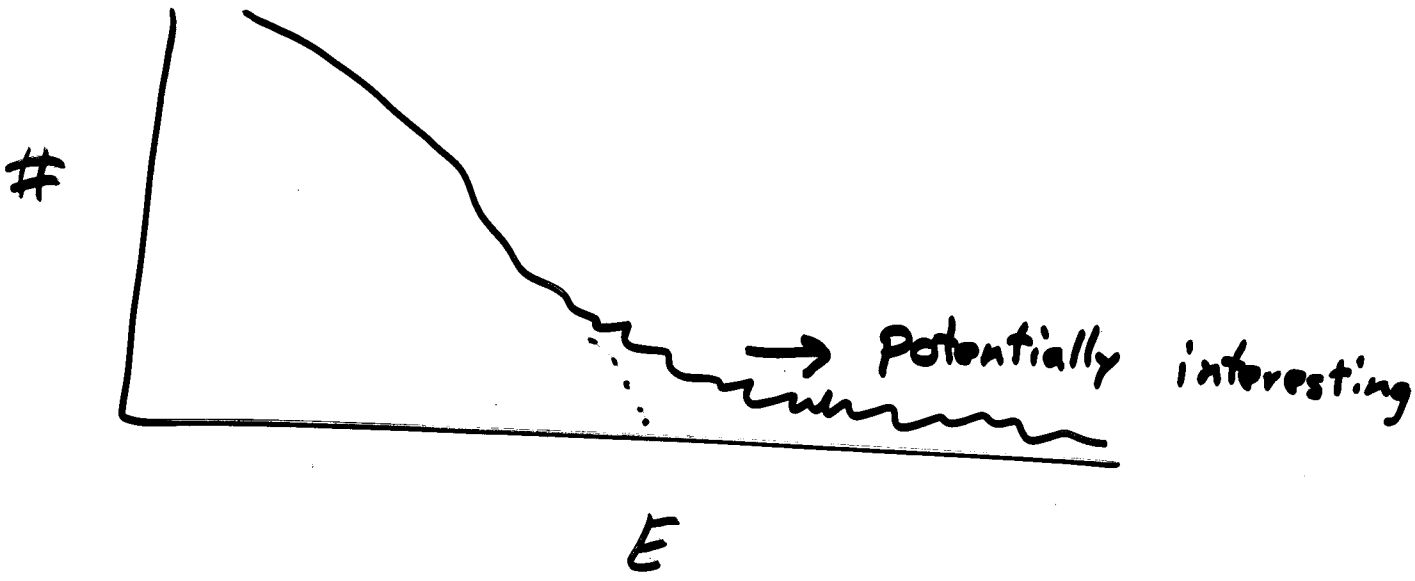
Momentum spectrum

- especially @ high P, lowered atmospheric ν background
- sampling completely different $P(E,L)$

Spectrum vs. zenith angle

Spectrum w/ direction & time

– A. Rahman



higher E cutoff ⇒ better S/N for astro

Where we want to be / Short term goals

1. Able to analyze CR/atm events ASAB-field — Science objectives

2. Ensure that we keep all needed information for later analysis — demuxing studies; surface/aux. detectors

3. Momentum analysis procedure — draft

4. Able to deal with temporal events (GRB/SN) — —

5. Data + simulation paths for CR analysis — Connect to simulations

Detectors above & beyond MINOS-FD

1. For CR studies (downward μ), a surface E_{shower} measurement is needed.

2. For CR studies of μ multiplicity deep underground, additional lateral spread would be required.

3. Top / bottom shield

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1. Existing Soudan-II surface detectors
   + New detectors under construction @ UMN
   + Student TBD

2. ?

Science summary

Cosmic-ray composition @ spectrum knee
(charge-sign of E_{shower}-tagged muons)

Astronomy with GeV neutrinos
(momentum spectrum + pointing/timing)

Atmospheric neutrinos - spectrum + composition
(charge-sign of atm $\nu \to \mu \Rightarrow \nu/\bar{\nu}$)

↑ These use the B-field ↑

Sun + moon shadow
Seasonal variations
Cosmic-ray airshowers
Special events